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ABSTRACT

A year-long study in 1991 that aimed to develop self-assessment skills in one third-grade class in Australia is reported. The roles that the length and naturalistic features of the study played in the success of skill development are explored. The class contained 20 students, ages 8-9 years, present for the whole school year (four 11-week terms). Selecting a specific curriculum area made planning and post-teaching reflection more manageable for the teacher. Science and technology was chosen for teacher interest and its congruence with the research aims. A self-assessment questionnaire was developed early in the year, based on ideas that students had about the skills they needed in science and technology. Students were introduced to concept maps and learned to produce them. Additional self-assessment was recorded in self-assessment graphs created by students. Specific self-assessment concepts and techniques introduced during each term are detailed. Students accepted the self-assessment tasks as teaching and learning strategies in their own right. Student awareness and use of skills in these class activities were substantially enhanced. The teacher's role changed as students became more proficient at self-assessment, until the teacher was functioning as a delegator, rather than as a dominating instructor. Nine figures illustrate student's concepts and list statements used in self-assessment questionnaires. (SLD)

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**DEVELOPING SELF-ASSESSMENT SKILLS
IN GRADE 3 SCIENCE AND TECHNOLOGY :
THE IMPORTANCE OF LONGITUDINAL STUDIES OF LEARNING**

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INTRODUCTION

This paper has two purposes. The major thrust is to report a year-long study which aimed to develop self-assessment skills in a single primary (elementary) class of Grade 3 (age 8-9 years) students. We then consider the obvious role of the length and naturalistic features of the study in the success achieved in the development of these skills.

THE CONTEXT OF THE STUDY

The first author conducted the study over a complete academic year (1991) with the Grade 3 class for whom she was the classroom teacher. Hence, although the notion of and approaches to self-assessment were introduced to and developed with the students in the context of science and technology, the broad philosophies underlying the intervention were pervasive in the class room. The class contained 20 students who were present for the whole year, and was located in a small non-government school in a middle-class Melbourne suburb. The school's academic year was organized around 4 terms of about 11 weeks each, the universal structure in Victorian schools, and our description of the study below is broken into these terms. The first author was undertaking the study as part of her Masters degree work at Monash University.

THE ORIGINS OF THE STUDY

In very general terms, these are in the Monash Children's Science Group (Gunstone & Northfield, 1988) and the Project for Enhancing Effective Learning, or PEEL project (Baird & Mitchell, 1986; Baird & Northfield, 1992). The first of these, the Monash Children's Science Group, was established by the second author in 1986 and the first author has been an active member for some years. This group involves science teachers, initially only from high schools but latterly with increasing numbers from primary schools, who are concerned with understanding and implementing the classroom implications of alternative conceptions research. Academics are also involved. The teachers and academics meet regularly to share collaboratively ideas and problems associated with teaching, curriculum, assessment and

arousing the interest of other colleagues in these approaches. The group, in common with the current thinking of many science educators, sees these aims (which might be crudely summarized as teaching for conceptual change) to be tightly linked with fostering metacognition approaches to learning. (This argument is elaborated in Gunstone & Baird, 1988.) Hence the ways in which science teachers in the PEEL project, a few of whom also belong to the Monash Children's Science Group, have developed these conceptual change-metacognitive links are important to the Group. This is enhanced by the development by PEEL teachers of the same links in other content areas.

The PEEL view of metacognition can be summarized as having learners understand and hence control their own learning. Self-assessment is clearly central to this. John Holt argued this nearly 30 years ago.

Part of being a good student is learning to be aware of one's own understanding. The good student may be the one who often says that he doesn't understand, simply because he keeps a check on his own understanding. The poor student who does not, so to speak, watch himself trying to understand, does not know most of the time whether he understands or not. Thus the problem is not to get students to ask us what they don't know; the problem is to make them aware of what they know and what they don't.

(Holt, 1964, p.23)

Other influential writers have argued the importance of self-assessment in broadly similar ways, for example Papert (1980) who believes that developing the skills of self-assessment enhances the prospects of students thinking more articulately about their own thinking, (and who asserts that "the best learning takes place when the learner takes charge", p.214) and Osborne and Freyberg (1986) who, in considering teaching motivated by alternative conceptions in primary school science, argue the importance to conceptual change of students taking responsibility for their own learning.

The importance of self-assessment is asserted by other sources, including older students. For example, Boud (cited in Falchikov & Boud, 1989) found the two most important skills for tertiary study identified by tertiary students themselves were problem solving and self-

assessment, skills for which these students claimed to have received little or no training in their formal educations.

Previous studies have sought to develop self-assessment skills. Loacker and colleagues (e.g. Loacker & Jensen, 1988), who have worked with students in higher education, argue that the development and acceptance of self-assessment requires long-term use of a variety of strategies by the teacher. For self-assessment to be successful, they argue, it must be carried out on a day to day basis where the student can relate to what they have learnt, how they have learnt it, how they will be evaluated, and what this learning means for the future. Reif (1990), who worked with Grade 7 and 8 students in English classes, asserts the importance of teachers learning to trust students in the development of self-assessment skills. The messages from these studies - the need for time, the importance of embedding self-assessment in learning contexts seen as part of the normal curriculum, the need for trust between teacher and student - are also central messages from the successes of PEEL project (Baird & Mitchell, 1986; Baird & Northfield, 1992). These messages were then also central to the thinking underlying the present study, and some approaches used in PEEL were adapted for use here.

Two previous Australian studies with primary school students also influenced this study. Swan (1990), working with the Grade 3 who were her allocated class, spent the year using diaries (called "Thinking Books" by the students) to foster students' thinking about their own learning. Each day each student wrote an entry in their thinking books about something he/she had learnt that day at school. Swan then read these and wrote a positive reaction of her own after each entry. These diary data showed an increase over the year in the quality and quantity of student ideas, as did a small number of concurrent case studies of individuals from the class. That is, Swan demonstrated that increases in student understanding of their own learning were possible with students aged 8-9 years. Simpson (1991), a teacher of a combined Grade 2 and 3 who began with more general ideas about student learning and the need for greater student independence in this process, gives an account of her use of a

favourite class story book as a starting point for science teaching. Story-related activities were used in the present study.

A FOCUS ON SCIENCE AND TECHNOLOGY

For both the teacher (first author) and her students there were significant reasons for focussing on one area of the curriculum in the attempts to foster self-assessment; for both students and teacher these reasons in part relate more to the earlier stages of the year. As all those involved became more familiar with and more accepting of approaches to self-assessment, then the less the teacher or students confined themselves to science and technology. Selecting a specific curriculum area was necessary for the teacher so as to make the task of planning and post-teaching reflection more manageable. For students, the need for approaches to self-assessment to be embedded in learning contexts seen as real was clear from other work (see, in particular, the PEEL project).

Science and technology was chosen for a number of reasons : the teacher's interest in this area; the technology education focus on designing/making/evaluating was seen as usefully congruent with the aims of the research; the commonly strong focus in primary science on mentally active individual processes such as observing and hypothesizing was also usefully congruent with research aims.

FOSTERING SELF-ASSESSMENT : APPROACHES AND OUTCOMES

Here we describe approaches and outcomes in chronological sequence. We consider each of the four terms into which the school year was divided in order. For Term 1 we describe the introduction of the project to the students, the development of three particular tasks used in each term (questionnaire, concept map, self-assessment graph) and some student products from these approaches. During Terms 2-4 specific class activities were used to foster self assessment. For each of these Terms we describe some activities, indicate ways in which the three tasks were further developed, and present some student data from the three tasks.

TERM 1

As well as the work already reviewed, two other sources were of value in giving ideas for the study. The current science and technology curriculum advisory document from the Victorian Ministry of Education includes a chapter titled "Learning How to Learn", and has been strongly influenced by alternative conceptions research and by PEEL. Another Ministry of Education product (Dalton & Smith, 19776) discusses a variety of activities related to developing independent learning skills. These, and a checklist of skills compiled by Dalton & Smith to aid teachers, influenced aspects of the study.

Introducing the study to the class: The initial introduction was open and honest. The intent of the study was explained to the students, including the teacher's higher degree enrolment, and emphasis was placed on the learning for both teacher and students which was intended. After this, work on the project in the first few weeks comprised a number of whole class discussions on the skills students would need in a science and technology activity. In some of the discussions the teacher made no input. Where appropriate, and when made possible by other class activities, the teacher also had one-to-one discussions with individual students. One highly significant purpose in these and other discussions described below is the belief that students of this age frequently need to formulate their ideas through conversation before expressing the ideas in writing.

The self-assessment questionnaire: As these initial discussions led to more and more students volunteering their ideas about skills needed in learning science and technology, the first step towards developing a self-assessment questionnaire was taken. Students were given the diagram shown in Figure 1 (adapted from Burton, 1986) and asked to write their ideas on the lines radiating from the circle.

(Figure 1 about here)

Responses then contributed to the construction of 12 statements for a self-assessment questionnaire. The questionnaire was completed by students using a Likert-style response

format. The 12 statements and the percentage responses for the whole class are shown in Figure 2. On the form completed by the students happy/unhappy faces were drawn to illustrate "strongly agree", "agree", "disagree", "strongly disagree" and a question mark used to illustrate "don't know". The questionnaire also provided five lines for "Comments" after the final statement. The comments offered by students are briefly considered in the concluding discussion about the Term 1 data.

(Figure 2 about here)

The concept maps: Concept maps, of the general form and purpose described by White and Gunstone (1992), were used because of their potential for both teaching about and evaluating student ideas about self-assessment. The students had not undertaken concept maps previously. The careful introduction then needed had advantages as the teaching role of concept maps was emphasized.

It was decided to begin with six terms relevant to self-assessment : "ideas", "thinking", "groups", "talking", "myself", "problems". These were selected from a consideration of the terms described in or implied by the 12 questionnaire statements (see Fig.2). The six terms were placed in front of the students in a whole class setting. Discussion of thoughts and feelings and some time rearranging the terms followed, and the intent of the task was described. The students were then placed in 3 groups, and each group produced a single concept map. These were displayed on the classroom walls to allow the students to see all 3 maps. Each student then produced an individual concept map. Throughout the group and individual concept map production the teacher responded to questions about the nature of the task and assisted students in forming and phrasing links. For both the group and individual concept maps students were encouraged to add any further terms they saw as appropriate to the task. One example of the individual concept maps is given in Figure 3, in both its original form and redrawn to enhance clarity.

(Figure 3 about here)

While the concept maps were of considerable interest in their own right, it was also intended to use this student product to help the student further "self-assess" him/herself. This was done by producing another set of statements (10 in number) from inspection of the concept maps and from discussions about the maps (whole class and individual). These statements became the basis of the "self-assessment graph".

The self-assessment graph: The 10 statements used for this task (shown in Figure 4) were of a different nature to the questionnaire. The questionnaire was of the form of an attitude scale, in particular in the use of a balance of positive and negative items and in the Likert-style response. The intent of the graph task was to use statements which represented possible student behaviours, and for the students to rate themselves on each. This was done by giving the students a 10 x 10 grid structure, with the 10 statements on the horizontal axis. Students then rated themselves out of 10 by drawing a bar graph for each statement on the grid. The statements, the frequency distribution of individual student responses and the class mean for each statement are in Figure 4. While we believe all statements are probably self-explanatory,

(Figure 4 about here)

some clarification was part of class discussion. In particular G ("To help other students") implies a student(s) feeling free to help other class members without seeking teacher permission, I ("To work with a good student") indicates a student could choose another seen to have a better understanding of skills to work with in an activity, and J ("To work with a weaker student") signifies a student choosing to use their own more advanced skills to help others needing support.

A summary of Term 1 self-assessment data: The student concept maps were encouraging in themselves. The quality of these, given the abstract terms being used, reflects both the extensive learning which took place during the carefully planned process of developing these individual concepts maps and the nature of student ideas about self-assessment which had been fostered through Term 1. While the example concept map shown in Figure 3 is a relatively

good one, it was not unique. One issue revealed by both questionnaire and graph was that students tended to not value listening to others as highly as was hoped for (questionnaire, item 6) or to rate themselves as having this ability (graph, item A). This led to a specific activity in Term 2.

The "Comments" section at the end of the questionnaire was valuable. It made clear that some students were still finding the written expression of ideas difficult, an observation which led to a more structured comments section in the Term 2 questionnaire. Even so, many students did comment. Their responses could be grouped into three categories : expressions of problems they were encountering (e.g. "I have problems having ideas come to me"); statements about ways of seeking/giving help with problems (e.g. "In my science lessons it is important to help other members of my group, so that problems can be solved"); expressions of feelings (e.g. "When I do this, like this, I can disagree with many things and I can agree with lots of things"). The range of comments were used to construct two new statements which were added to the questionnaire for Term 2.

TERM 2

The processes described above which were used to introduce and develop the questionnaire, concept mapping and graphing tasks were, of course, important classroom (learning) activities. The data from these three tasks were now used to plan activities focussing on self-assessment skills. For convenience we now refer to these as "classroom activities", although this should not be taken to indicate that the second uses of questionnaire/concept map/graph towards the end of Term 2 were not also "classroom activities".

Classroom activities: The first activity which was introduced was a skills chart which listed the skills found on the Term 1 self-assessment graph (see Figure 4). Each student was given a copy of the chart to keep in their science book. At the end of each science activity, the student recorded the skills he/she believed had been used in the activity. The teacher

predicted before each activity the skills she believed would be used. By checking her predictions against the students' responses the teacher was able to monitor the extent to which an activity could have developed the skills it was planned to.

A whole-class skills chart was also introduced and displayed. On this, students (in the small groups in which they had been working) recorded the self-assessment skills they had used for each day. Observation made it clear that this served its intended purpose - as the term progressed students came to cluster at the chart discussing their ideas and feelings about the skills they were using.

A third activity to develop the skill shown to be less valued on the Term 1 questionnaire, that of "listening to other people" was introduced. The teacher began by asking students what was the difference between "hearing" and "listening". (The question was phrased in this form of a difference existing.) Responses were generally of the form that hearing is passive (e.g. "... you're only hearing them, your (sic) not thinking about it") and listening as active (e.g. "listening is understanding and knowing what that person is saying to you"). This active aspect of listening was then built on via a series of lessons designed around the need for students to listen for specific instructions, and hence to demonstrate the skill of listening before carrying out the activity. At the same time considerable encouragement was given to the asking of questions if instructions were not understood, and the intertwined nature of the skills of "listening" and "asking questions" was emphasized. Discussions with students through the term suggested that this was the beginning of general student realization that self-assessment skills were dependent on each other when used appropriately.

A token system was also introduced in Term 2, a system used previously by this teacher with a Grade 3 and by another teacher in the school with a Grade 4. In this system teacher and students initially discussed the skills thought to be needed for an activity before beginning. As the students then worked in groups (of 2 to 4) the teacher observed the skills students used. On concluding the activity students made an assessment of the skills they had or had

not used. The teacher then gave one token of one colour for each skill used by the student, and one token of the other colour for each relevant skill not used or used poorly. Students were not told which colour represented use and which non-use. During subsequent discussions with each group the students established the teacher's intent with the tokens. Students were encouraged to dispute the teacher's opinion, but only if the dispute was accompanied with reasons. A record of this process was kept by the teacher and students could use this to review their progress.

The self-assessment questionnaire (Term 2): Towards the end of Term 2 the self-assessment questionnaire was again completed by the students. Statements related to "expressing opinions" and "developing new ideas" were added to the questionnaire as a result of an analysis of the open-ended comments section on the Term 1 instrument. In addition, the 12 Term 1 statements were reworded in an attempt to reduce influence of any remembered Term 1 response. This new wording was used in Terms 2 and 4, the original wording in Terms 1 and 3. A comparison of the statements in Figure 2 (Term 1) and Figure 5 (Terms 2 and 4) shows the minimal degree of change. Figure 5 presents data for the four self-assessment questionnaires (Terms 1, 2, 3, 4), with the wording of statements being that used in Terms 2 and 4. As noted on Figure 5, some statements were added in each of Terms 2, 3 and 4. The "Comments" section which followed the 16 statements on the Term 2 questionnaire was structured by giving 4 questions: "What do you need to do next?", "What are your strengths and weaknesses?", "What have you learnt?", "What problems do you still have?".

(Figure 5 about here)

The concept maps (Term 2): Because of particular emphases in the activities designed for Term 2, it was appropriate to provide a set of terms for the concept map task which reflected something of the purposes of the activities. Figure 6 shows the terms given, and those given for Terms 1, 3 and 4, set out to emphasize identical or similar terms. Group maps were not produced on this occasion as most students favoured doing their own maps.

(Figure 6 about here)

Before beginning a discussion was held with those students who wanted to explore in this way their ideas about the seven terms. Again, students were encouraged to add any further terms they wished.

The self-assessment graph (Term 2): As with the questionnaire, the Term 1 graphing task was repeated with the addition of new statements. These new statements, and the further additions on the Terms 3 and 4 graphing tasks, reflected emphases during the term's activities. No rewording took place on the graphing task; the descriptions of skills used in this task were deliberately very familiar to the students through class activities. The Term 2 task is shown in Figure 7, as are the Term 1, 3 and 4 graphing tasks and the class means for each item.

(Figure 7 about here)

When the Term 2 graphing task was given many students asked to see their Term 1 individual graphs, giving as their reason that they needed "concrete evidence" of themselves as self-assessors in Term 1 in order to more "accurately" rate themselves in Term 2. This was, of course, done. The request was powerful evidence of the acceptance of the value of self-assessment by students.

Summary of Term 2 self-assessment data: The graphing task data, when context is considered, are particularly interesting. Figure 7 shows a substantial rise in average self-rating on "Listening to other people", a skill on which there was a strong focus during Term 2. A number of other skills showed a drop. Discussions after the task had been completed showed a widespread student belief that they had over-estimated their skills on the Term 1 graphing task (their responses to which they asked to see before completing the Term 2 graph). Many students also expressed the belief that their skills had improved during Term 2, but that they should now rate themselves lower than at the end of Term 1. This recognition of what could still be learned, of some of the complexity in these skills, and of their previous greater naivety was another powerful indication of development of self-assessment.

Aspects of growing recognition of complexity were also evident in the questionnaire data. For example, consider statement 10 (Figure 5). The class mean shows a continued mild disagreement. However buried in this figure is a substantial rise in "don't know". Some of these students wrote in the comments section that "don't know" was chosen because "it depends, sometimes they are right, sometimes not". Other comments in this section indicated skills claimed to have been learnt (e.g. patience), perceived strengths and weaknesses (e.g. "I am not that confident at doing things I have never done before"), what was seen to be the next skill to tackle (e.g. "I need to be able to ask questions when we discuss things") and problems still seen (e.g. "I answer people back").

Some concept maps showed further development, for example one student added a further 8 terms to the 7 provided (see Figure 6): science activities; inventor; invention; friends; technology; understanding and learning; experiment; observing. Links on this map included "I don't always have to listen to my friends", "By asking questions I can develop my opinions", "My questions can help my friends learn more", "I can discuss with my friends and learn to think of new ideas".

TERM 3

A vacation assignment: An assignment was given for the two week vacation between Terms 2 and 3. This comprised a skill chart, a request to tick each day "2 or 3 skills you have used successfully during the day" and to add any other skills to the list as appropriate, and to write at the end of the vacation a short comment about how the student saw use of the skills contributing to their development and learning. The intent of the assignment was to foster the view that the self-assessment skills being emphasized in the classroom were of use, even value, at home. The chart and comments were returned to school at the beginning of Term 3. A number of the student comments describe skills the student saw he/she needed to improve, another sign of the growth of self-assessment. Even more interesting was a number of letters from parents (unsolicited) commenting very favourably on the Terms 1 and 2 work and the

vacation assignment.

Classroom activities (Term 3): The computer became a focus of activities in this term. (The class had access to p.c's in the classroom). After discussions about the nature and uses of computers, the students worked in groups of 2 or 3 on the task of designing a "slide show" (using the software "Slide Shop") on the value of the skills which they had been learning. The intended audience for this slide show was to be Grade 1 or 2. The activity was intended to provide a focus on developing the skills of "designing" and "planning". It began with a brainstorming whole class session to consider issues of slide format and wording. As groups produced slides, pairs of groups discussed these products. On completing this task each group then produced a self-assessment questionnaire to accompany the slide show.

The second major activity of Term 3 used the approach taken by Simpson (1991) in the use of stories. A book was selected from the class core reading scheme, and students individually listed the skills used by the main story character. Students then put each skill into a sentence which expressed their ideas and feelings about the character. The teacher had independently created her own list of skills exhibited by the main character. Subsequent discussion in small groups focussed on each other's ideas, their sentences, and the teacher's list. These discussions revealed a developing awareness of interactions between the character's skills and the involvement of other characters. Other stories were introduced by the students (e.g. skills used by Robin Hood as depicted in the recent Kevin Costner film version of that story).

Questionnaire, concept map and graph (Term 3): In the last two weeks of Term 3 these tasks were again given. The Term 3 versions are shown in Figures 5 (questionnaire), 6 (concept map) and 7 (graphing task). Of the 9 concept map terms given, 2 ("using a computer" and "being creative") were initially withheld. Once students were well advanced with the remaining 7 terms, they were asked to add these 2 and then encouraged to add extra terms of their own.

Summary of Term 3 self-assessment data: The use of 9 terms for the concept map did not appear to create any problems. Many students added extra terms of their own with some students including 8 extra terms. The complexity of the maps, with up to 17 terms included, was most impressive and created difficulties for the teacher because of the time required for analysis. There was a consistent expression through most maps of greater independence and self confidence.

In considering jointly the questionnaire and graphing data, a number of points emerge. "Being creative" (item K, Figure 7) was rated substantially higher, an observation supported inferentially by the data from a number of questionnaire items (e.g. items 15 and 16, Figure 5). As with "listening" in Term 2, students had thus learned to have developed substantially with a skill on which there had been a major activity focus. For other skills there was a pattern of questionnaire data suggesting student valuing of the skill but graphing data suggesting student perception of relative weakness in their ability to use the skill (e.g. "Asking questions" and, perhaps, "Listening").

The "Comments" section on the questionnaire was, for Term 3, focussed by a single instruction: "Write a short comment about yourself as to how you are becoming better at 'self-assessing' yourself". Some comments were relatively bland (e.g. "I have become a better self-assessor with the help of Mrs. Rudd and the Year 3 skills chart") but others were impressively self-analytic (e.g. "I have learnt to be confident. One of my weak skills is understanding and knowing which I got to work on more (sic)", "...I think that I have become more observant because the children in the class gave me ideas about observing, not only that I have become more confident but I have to be more organized too."

TERM 4

It is common for the final school term in Victorian schools to be more frequently disrupted with extra-curricula activities. This term with this class was no exception, and the teacher was consequently sometimes absent from the class. A replacement teacher was

present. Even so, the teacher attempted to use these occasions in ways consistent with the research project by encouraging students to take control of the work set for the day.

Classroom activities (Term 4): Specific activities began in Term 4 with further work on the slide show developed in Term 3. The class, with help from the teacher, designed a single questionnaire related to the slide show. The questionnaire is shown in Figure 8.

(Figure 8 about here)

The students then used their slide show to teach the Grade 1 students in the same school. After completing this the Grade 1 students completed the questionnaire. (The process involved each Grade 1 selecting a Grade 3 student to help them with reading and completing the questionnaire). The Grade 3 students, in small groups, then wrote a report about the teaching and the questionnaire data.

The teacher then asked the students to consider ways of reinforcing the teaching of Grade 1 about skills. This led to the student design of individual board games based on the skills in the questionnaire. The games were trialled within Grade 3, and then each Grade 3 taught their game to one Grade 1 student. After playing the game the Grade 1 student filled in a form of self-assessment graph, with the help of their Grade 3 partner. These data were pooled and a whole-class graph produced by the Grade 3's.

The final Term 4 activity was an extension of the use of stories in Term 3. Another story was read and students listed the skills they considered had been used by the main character. Each student then gave a mark out of 10 for the use of each skill by the main character (i.e. did a "self-assessment graph" for the main character). These were compared with the teacher's product for the same task. Marks were comparable for the skills the teacher had identified. However the students identified more skills than had the teacher.

Questionnaire, concept map and graph. (Term 4): The forms of these tasks used in Term 4 are shown in Figures 5-7. As in Terms 2 and 3, students had their previous self-assessment graphs returned to them for consideration before doing the Term 4 task. The number of terms

given for the concept mapping task was less than in Term 3, a reflection of the extent to which the Term 3 maps included extra terms added by the student. Of the 6 terms given, 3 were "being independent", "concept map", "self-assessment". The inclusion of these was obviously related to this being the final concept map. For the same reason no comments section was included on the questionnaire.

Summary of Term 4 self-assessment data: The concept maps were broadly similar to those of Term 3 - most contained a substantial number of terms added by the student, linking of terms was much more substantial (particularly in comparison with Term 1), and the nature of the links again showed insight. An illustration of the Term 1 to Term 4 changes is given in Figures 9a and 9b where the concept maps of one student (pseudonym "John") for Terms 1 and 4 are shown.

(Figures 9a and 9b about here)

The general picture given by the three Term 4 data sources is cohesive. All but three of the average ratings for the skills on the graphing chart rose from Term 3, and the questionnaire data, concept maps and classroom observations all support the view that this increase in self-rating was justified. The data are also consistent with the teacher's observations that the attempts to further increase student responsibility for learning in this Term were successful. We turn now to a consideration of the year as a whole.

CONCLUSION: A CONSIDERATION OF OUTCOMES AND OF THE IMPORTANCE OF THE NATURE OF THE STUDY TO THESE OUTCOMES

In the introduction to this paper we referred to the role of the longitudinal and , naturalistic features of the study in its success as "obvious". This may now be the case for readers. Nevertheless we address this issue, but, because the "obviousness" derives from the intertwined nature of the methodology of the study and its outcomes, we consider outcomes and methodological features together.

The embedding of the study in a whole school year as part of the curriculum to be

considered had a number of positive effects. Two were particularly powerful.

First, the tasks designed to assess the development of self-assessment skills (questionnaire/concept map/graphing) became teaching/learning strategies in their own right, and clearly accepted as such by students. They became, in the students' eyes, part of legitimate school activity, part of normal school life. (Other studies have shown how difficult it can be when one attempts to change students' ideas and beliefs about learning, teaching, and the roles it is appropriate for learners and teachers to take; see in particular the work of the PEEL project already cited.) It seems clear to us that a major factor in this relatively rapid student acceptance of the validity of our purposes for the study was the primary school setting - one teacher full-time with the grade. Although we have no obvious data to support this, it is consistent with other primary school work (Swan, 1990) and the high school work of PEEL. It could only occur in such a naturalistic and longitudinal setting.

The most obvious example of student acceptance of the validity of the tasks designed to assess development was the demand by them in Term 2 to see their Term 1 self-assessment graphs. This behaviour in itself was a powerful indicator of development. Concept maps also show acceptance of task. Consider the changes in the two concept maps shown in Figure 9. The Term 1 map is quite disjoint, even though "John" had added five terms of his own. The Term 4 map shows a much more intertwined view, and even includes two links between one pair of terms.

The second of the two particularly powerful effects of embedding the study in the normal curriculum is similar to the first. It concerns the activities designed to promote the development of self-assessment. These classroom activities were both powerful development experiences and powerful indicators of development. While there are many examples of this, none is more obvious than the Grade 3's teaching and assessing the Grade 1's about skills. Seeing how a student approaches teaching X is a powerful assessment of that student's understanding of X. (See, for example, McDougall, 1988.)

At the commencement of the year the students showed very little understanding of the skills they thought would help them become successful self-assessors. At this time they tended to set unrealistically high goals for themselves, and then became frustrated when their achievements did not match these expectations. Acceptance of more realistic goals, or if you will, acceptance of something of the complexities and subtleties of self-assessment, was not easy. However it was relatively rapid (well within Term 1). A major part of this was the student acceptance of the legitimacy of the activities. Much of this came from the teacher's approach of working with the students to establish aspects of activities and realistic goals. Again, this could not have occurred without the naturalistic and longitudinal approaches. The second author, for example, could not have achieved this had he worked with the class. In the students' eyes he would have been an outsider, and the demands he attempted to make likely would be rejected as inappropriate. (The activities the class teacher had students accepting were, it must be remembered, much more demanding than usual class activities.)

We assert, on the basis of all data from the year, that student awareness and use of skills involved in these class activities was substantially enhanced. In summary, we see this enhancement in

- development of students' ability to plan and think through their goals and skills;
- the creation of student awareness of the importance of evaluating their own work, and how this evaluation could assist further progress in learning;
- students' abilities in evaluating each other's self-assessment and in then providing constructive criticism;
- students' abilities to manage resources and time more effectively.

One way of considering the whole year is in terms of broad changes in the role adopted by the teacher. Through the year the teacher moved successively through four sequential roles for which we now give descriptions via metaphors. We call these "Stages" because of the broad linear sequence, but we are anxious that the use of "Stages" not be taken to imply that

the first must be completed before the second is begun.

Stage 1 - The teacher as instructor: Here the teacher is dominant in shaping what is to be done and how. The teacher "instructs" students in learning to apply necessary skills in a given activity. (Even so, it is important to remember that in this study the skills were those students had considered to be helpful with their learning.)

Stage 2 - The teacher as coach: Now the teacher-student relationship moves towards a form of partnership, but the teacher is still more dominant than the student. The teacher "coaches", and uses collaborative discussions to help focus student on particular issues.

Stage 3 - The teacher as counsellor: We still have a partnership in the form of Stage 2, but now the student is more dominant. The student is encouraged to decide for him/herself the skills needed for particular activities, the teacher is available for "counselling" when students need help and advice.

Stage 4 - The teacher as delegator: The student is now encouraged to be dominant; crudely, to have the role taken by the teacher in Stage 1. The teacher "delegates" the work to the students, and they are responsible for applying previous learning to the work.

We conclude with a further comment about the naturalistic/longitudinal features of the study. The successful incorporation of the study in the "normal school life" of the student also necessarily means a diminished concern with generalizability. This we see as positive, not negative. It allowed the serious and wholehearted pursuit of complex, subtle and important outcomes. That such success was achieved is important, if only in terms of being able to demonstrate that such aims can be appropriate with young children. The focus on a single classroom has also put to one side the potential importance of features of the school and this class, for example, the students coming from families generally more informed about and enthusiastic for education than is the case in some other schools. The positive aspect of placing such variables to one side is the generation of a range of co-ordinate activities, approaches and assessments for others to explore and adapt in their own contexts.

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Name____ Age____ Term 1.
Boy____ Girl____

When I am in
my science lessons,
I can.....

Figure 1: First approach to the collection of student ideas

	Statements	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1.	When I am doing my science activity I can think of new ideas.	45	45	5	5	0
2.	When I am not sure of something I don't need to ask questions.	10	0	15	35	40
3.	When I am working on a science activity it is important to draw and make notes of my ideas.	70	30	0	0	0
4.	School is the only place where I can learn science.	10	0	0	20	70
5.	When I am in my science lessons I can try to use ideas from other class activities.	45	35	10	0	10
6.	In my science group it is not important to listen to the other members of the group.	35	20	5	5	35
7.	In my science lessons it is important to help other members in the group.	65	15	5	5	10
8.	It is not important to share ideas with other people in the group.	20	20	5	0	55
9.	When I am working on a science activity, it is important to give myself time to think out the problem.	65	15	15	0	5
10.	Discussing the science activity with your friends does not help you to solve the problem.	15	15	0	25	45
11.	When I have finished my science lesson, it is useful to think where I could have had more help and support.	75	25	0	0	0
12.	I can only work on my own when I am doing a science activity.	0	5	15	5	75

Figure 2: Statements used on Term 1 self-assessment questionnaire, plus whole class data (percentages, n=20).

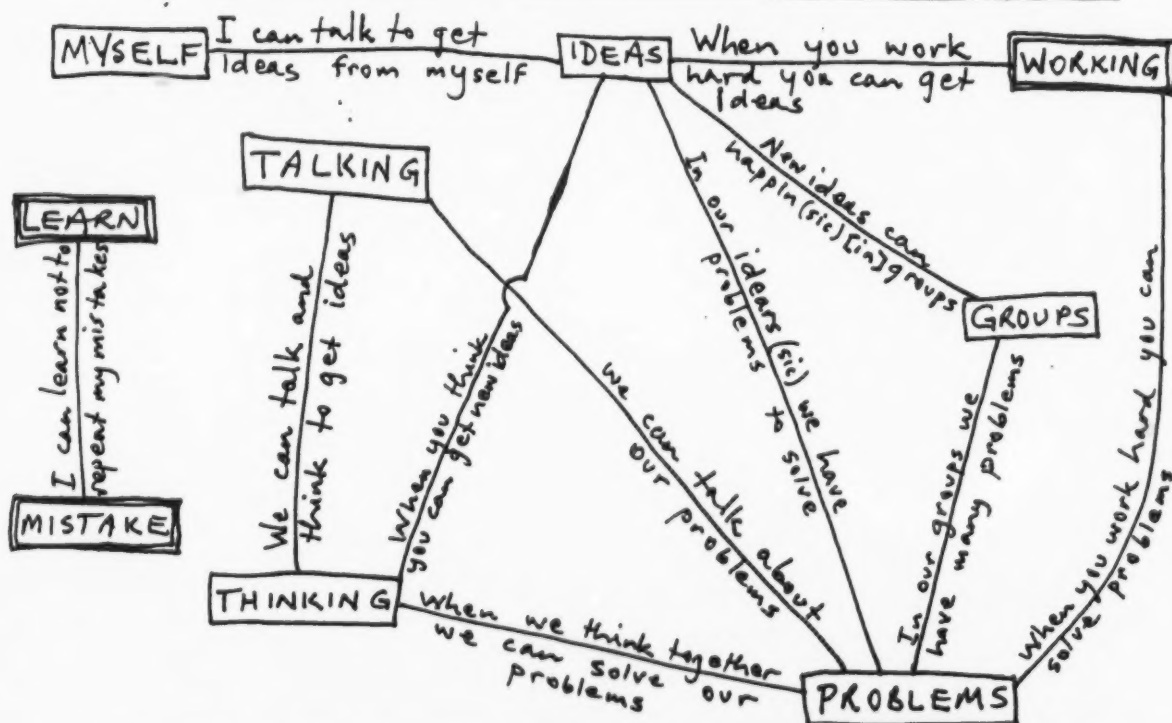
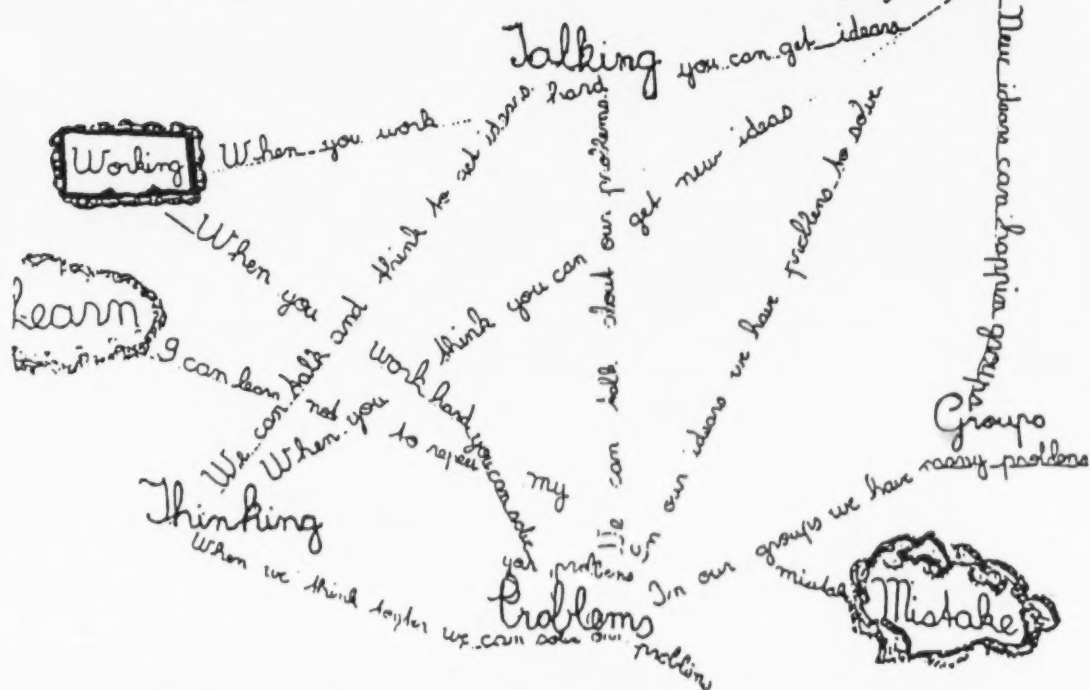


Figure 3 : Sample concept map from Term 1, original and redrawn for clarity. (Terms in double boxes on redrawn map are those added by the student.)

	1	2	3	4	5	6	7	8	9	10	AVG
	Score (1 to 10)										
A Listening to other people	2	1	5	6	3	0	0	0	1	0	3.7
B Watching other people	0	3	3	4	4	3	1	0	0	0	4.2
C Asking questions	0	1	3	2	3	1	1	4	3	0	5.9
D Working in a Group	0	3	3	3	0	2	1	4	2	0	5.3
E Discussion	0	0	3	3	3	4	2	1	1	1	5.6
F Working with a teacher	1	3	0	4	2	3	2	0	1	2	5.2
G To help other students	1	1	5	0	3	3	1	3	1	1	5.6
H To work on my own	1	3	4	1	3	0	1	2	2	1	4.9
I To work with a good student	0	4	1	2	2	3	3	0	0	3	5.4
J To work with a weaker student	2	4	2	2	5	1	1	0	1	0	3.9

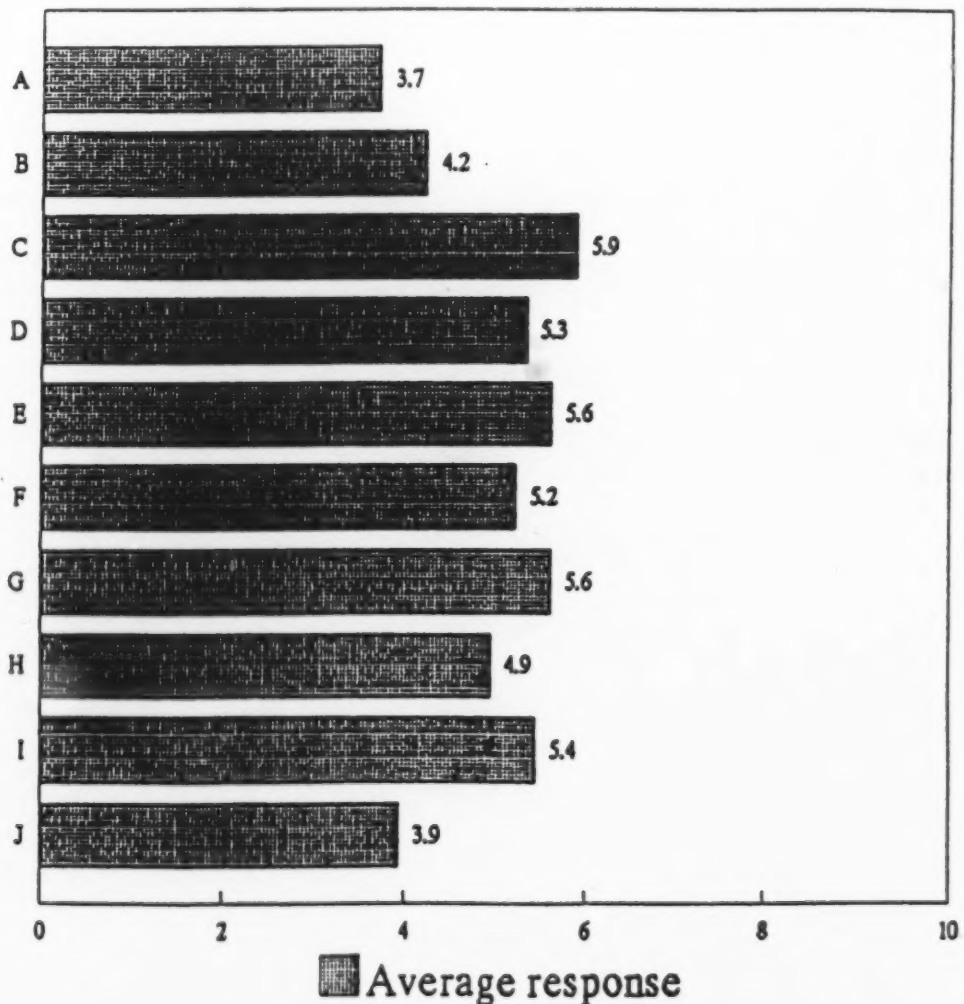


Figure 4 : Statements given on Term 1 self-assessment graphing task, distribution of individual ratings, and class mean ratings.

Statements	End of Term			
	1	2	3	4
1. I can think of new ideas when I am doing a science activity.	1.3	1.4	1.6	1.7
2. I don't need to ask questions when I am sure of something.	-0.9	-0.7	-1.1	-0.9
3. It is important to draw and make notes of my ideas when I am working on a science activity.	1.7	1.5	1.4	1.2
4. I can only do science when I am at school.	-1.4	-1.6	-1.6	-1.9
5. It is important to use ideas from other class activities in my science lessons.	1.0	1.2	1.4	1.2
6. Listening to other people in my group is not important when I am doing a science activity.	0.1	-1.4	-1.5	-1.0
7. It is important to help other members of my group when I am doing a science activity.	1.2	1.6	1.7	1.5
8. When working with other people in the group, it is not important to share ideas.	-0.5	-0.7	-1.1	-1.5
9. It is important to give myself time to think out problems when I am working on a science activity.	1.3	1.3	1.8	1.6
10. Discussing the science activity with your friends does not help you solve the problem.	-0.7	-0.5	-1.4	-1.5
11. It is useful to think where I could have had more help and support, when I have finished my science activity.	1.7	0.9	1.1	1.4
12. When I am doing a science activity I can only work on my own.	-1.5	-1.6	-1.8	-1.8
13. When I am working in a group, doing a science activity, I don't need to agree with everything that the group says.	*	0.4	0.9	1.3
14. It is important to agree with all members of the group when I am doing a science activity.	*	0.4	-1.1	-1.2
15. When I need to think of new ideas in my science activity, I go to my teacher for help.	*	0.3	-1.6	-1.2
16. In my science activities, when I need to think of new ideas I can ask the members in my science group.	*	0.5	1.6	1.2

Statements	End of Term			
	1	2	3	4
17. I find it easy to bring my ideas together, when I use a computer.	*	*	0.3	0.8
18. When working with other people, being patient is an important skill to develop.	*	*	1.7	1.4
19. It is important for me to develop self assessment skills, so that I can learn and understand my school work better.	*	*	1.1	1.5
20. When I am working on a computer it is not easy to use my ideas.	*	*	-0.8	-1.0
21. When working with other people it is not important to develop the skill of being patient.	*	*	-1.1	-1.5
22. To understand and learn about new ideas, having too much confidence is not helpful.	*	*	-0.8	-0.4
23. Self-assessment skills do not help me with my homework.	*	*	*	-1.4
24. I feel it is easy to understand and learn about new ideas when I am feeling confident.	*	*	*	1.2

Figure 5 : Questionnaire statements and class mean responses for the 4 Terms.
 (* indicates statement not included for this Term; means calculated from scores of 2, 1, 0, -1, -2 for Strongly Agree, Don't Know, Disagree, Strongly Disagree.)

Term 1 (6 terms)	Term 2 (7 terms)	Term 3 (9 terms)	Term 4 (6 terms)
ideas		my ideas	new ideas
thinking			
groups	groups	groups	
talking	discussing	discussing ideas	
myself		myself	myself
problems			
	asking questions	asking questions	
	my teacher		
	listening/watching		
	being creative	being creative	
	my opinion		
		being confident	confidence
		being patient	
		using a computer	
			being independent
			concept map
			self-assessment

Figure 6 : Terms given by teacher for each concept mapping task

Skills	End of Term			
	1	2	3	4
A. Listening to other people	3.7	6.0	6.5	7.6
B. Watching other people	4.2	4.8	5.9	6.3
C. Asking questions	5.9	4.8	4.9	5.1
D. Working in a group	5.3	4.9	6.2	6.1
E. Discussion	5.6	4.5	5.2	6.7
F. Working with a teacher	5.2	5.2	5.9	6.2
G. To help other students	5.6	4.8	5.7	6.2
H. To work on my own	4.9	5.2	7.3	7.1
I. To work with a good student	5.4	4.6	5.5	5.4
J. To work with a weaker student	3.9	4.3	4.6	5.7
K. Being creative (new ideas)	*	4.3	6.7	7.1
L. Forming and expressing opinions	*	4.3	5.7	6.8
M. Being patient with other people	*	*	5.7	6.1
N. Being confident with myself	*	*	7.5	7.9
O. Using a computer	*	*	6.5	7.1
P. Independent learner/thinker	*	*	*	6.7

Figure 7 : Skills given and class mean ratings for the 4 self-assessment graphs
 (*indicates skill not included for that Term.)

Name-----

Age-----

Skills.

What is a skill?

A, Something I can do? ☐B, I don't know. ☐

Which are skills? Tick the ones you know.

Listening

Table

Kicking

Sharing ideas

Chair

Helping

Understanding/Knowing

Eating

Watching

Asking questions

Which are your good skills?

Yes

No

Listening

Watching

Helping my friend

Asking questions

Figure 8 : Questionnaire designed by Grade 3 students for use with Grade 1.
 (Non-instances of skills are intended to be "table", "chair"; "kicking" included as a psychomotor skill (football), "eating" included as a social skill.)

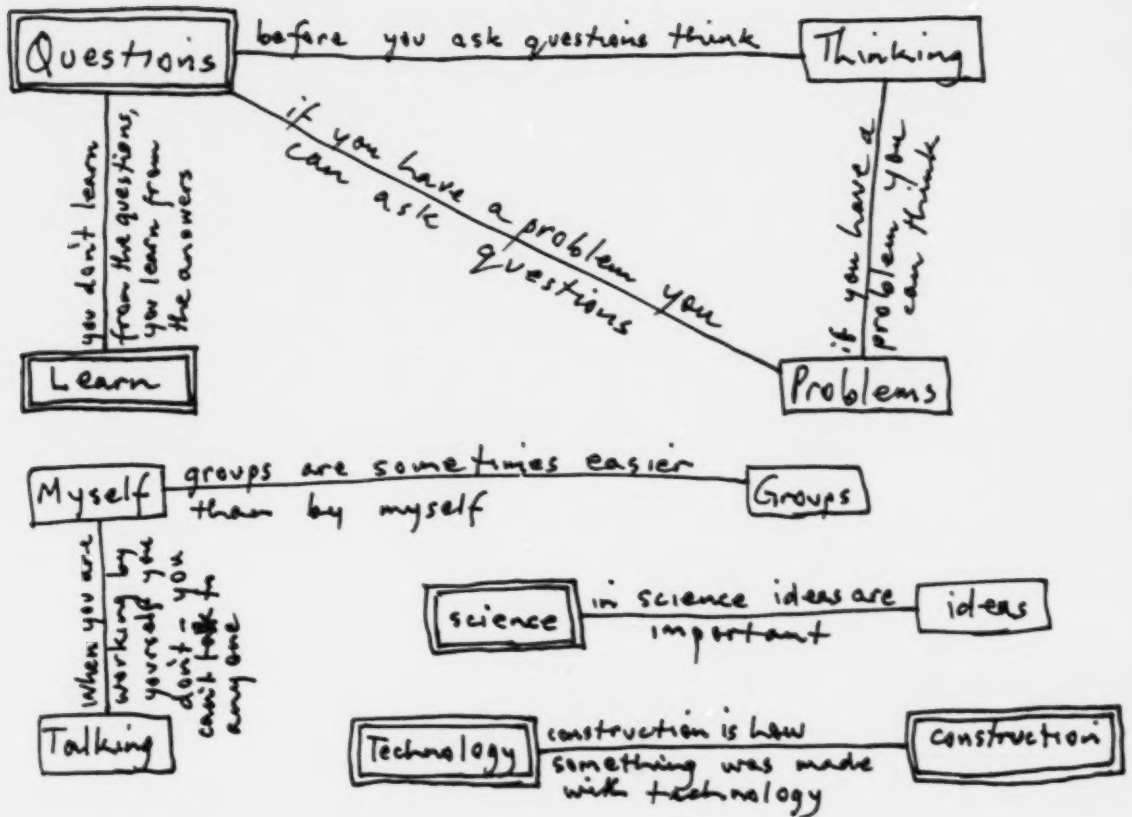


Figure 9a : Term 1 concept map produced by "John" (redrawn and rearranged for clarity).

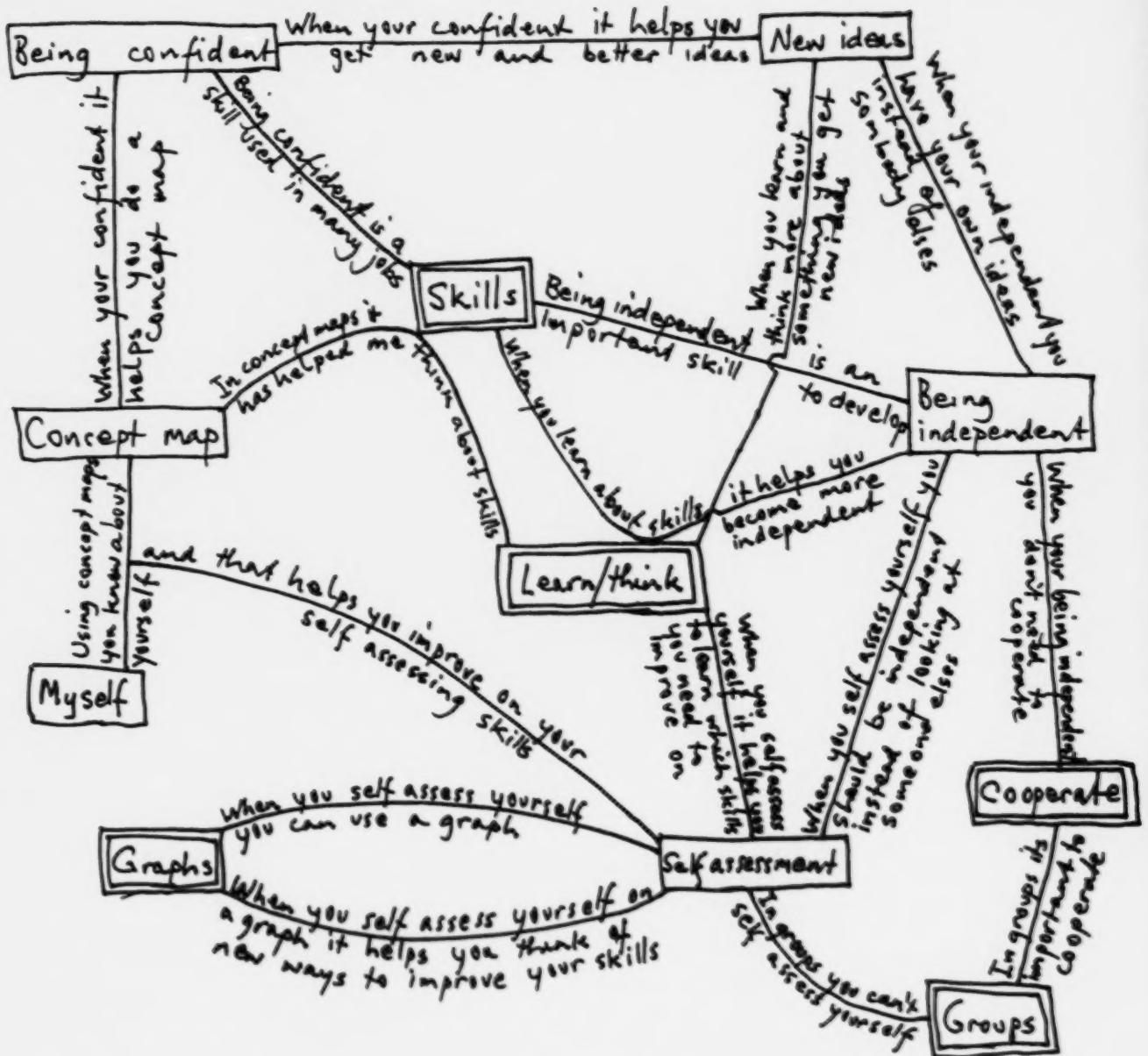


Figure 9b : Term 4 concept map produced by "John"
(redrawn and rearranged for clarity).